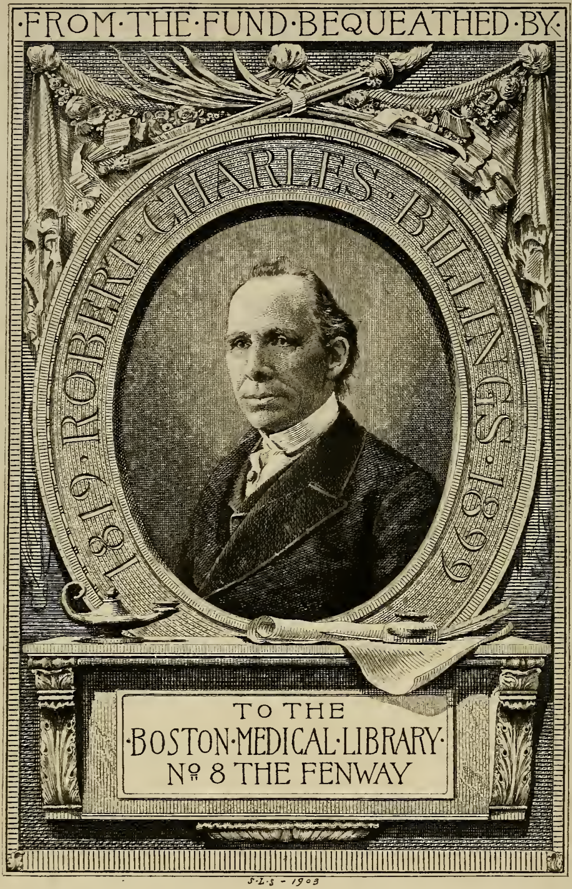
PHTHISIS AND ITS GERMS

BY

WILLIAM JOHNSON SMYTH, M.D.



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PHTHISIS AND ITS GERMS.

ALTHOUGH Koch was preceded in his enquiries into the etiology of tuberculosis in general, and tubercular disease of the lungs in particular, so far back as 1697, by Morton (*1*), and at later dates by Laennec, Von Basle, and Virchow; although it seemed that Villemin in 1865, and later on Cohnheim (*1x*), had all but arrived at a solution of the mystery, yet it was reserved for the first named (*2*), on the 22nd March, 1882, before the Physiological Society of Berlin, to declare that his enquiries had led him to the discovery of the true cause in the production of tuberculosis.

The conditions limiting the subject and the dimensions of this essay preclude me from giving in full the whole of Koch's famous research, then set forth in such conscientious detail. The importance of his discovery, the order of the irresistible evidence and logical thought which led to it, is however, so impressive that I hope I may be within the domain of relevancy if I briefly indicate the outlines of his work.

The researches of Villemin and Cohnheim provided Koch with the knowledge that the minute millet seed-like bodies known as tubercles, which were found present in tuberculosis, contained the specific element of the disease, being capable of producing a similar disease when inoculated into other animals.

Koch, by efforts that seem untiring, at last, by an alkaline solution of methylene-blue, succeeded in staining a micro-organism which he called the Bacillus Tuberculosis. These bacilli he described as slender rods, two to four microns in length, straight or slightly curved, rounded at the ends, and often presenting a beaded appearance, They were found in pairs, bundles, or singly. They were sometimes accompanied by spores, either within their own structure or in the adjacent tissues. Furthermore, he described them as motionless.

Having discovered the bacilli, Koch set about isolating and cultivating them outside the human body.

Under strict antiseptic precautions, he dipped the point of a needle into a tubercular nodule in a newly killed animal; he drew that point across the surface of some solidified blood serum in a test tube; he kept the test tube in an incubator at 37° C. and in a slightly moist and thoroughly sterile atmosphere ; whereupon he had the satisfaction of observing that in ten days a growth appeared presenting the appearance of little whitish or yellowish scales or grains. On microscopically examining these scales they were found to be pure cultures of the "Bacillus-Tuberculosis" and of this alone.

From the cultivations thus made, specks on the point of a needle were transferred to other tubes containing solidified blood serum in which colonies of similar bacilli again sprang up ; and so on through many tubes and many generations of bacilli. And, last of all, Koch took the pure cultures of the bacilli thus obtained and inoculated them under the skin in some, and into the blood or serous cavities of other healthy animals, in all of which invariably in due course tubercular disease, marked by the presence of tubercles with their swarms of bacilli identical with those first isolated, developed.

Koch thus crowned the edifice of his great labours, and put it beyond cavil for ever that this bacillus is the one true cause of tubercular disease. Koch finished his address with these words, "We can, with good reason, say that the bacillus tuberculosis is not simply one cause of tuberculosis, but its sole cause, and that, without the 'bacillus tuberculosis' you would have no tuberculosis."

Koch's investigations, whilst directed towards tuberculosis in general, were directed chiefly towards the solution of the etiology of Phthisis—tubercular disease of the lungs.

The researches of other pathologists subsequently have confirmed the decision of Koch in 1882 regarding the essential factors in the causation of tuberculosis. I submit therefore that to be pathologically orthodox is to accept the conclusions of Koch, viz., that the essential factors in the production of tuberculosis—and of course Phthisis—are the Bacilli Tuberculosis, also called by Koch the "Tubercle Bacilli."

Since Koch's discovery in isolating the essential micro-organisms which produce Phthisis, other enquiries have shown that other micro-organisms may have a very important part, if not always, yet frequently and indirectly, in producing the disease, or in hastening its progress.

I shall therefore approach the consideration of "Micro-organisms as Factors in the Production of Phthisis" by arranging into three groups the micro-organisms which I consider most directly related to the disease, describing those I consider the most important, and, as far as I can, the rôle played by each.

CLASSIFICATION OF MICRO-ORGANISMS AS FACTORS IN THE PRODUCTION OF PHTHISIS.

I. The Essential Micro-organisms for the Production of Phthisis; the Tubercle Bacilli.

II. Those presumably aiding the Tubercle Bacilli either by (1) exalting the virulence of the attack of the latter ; or (2) by the production of other diseases enabling the Tubercle Bacilli to enter the body, or when there, to successfully invade the individual now debilitated by these allies ; Pfeiffer Bacilli, &c.

III. Those associated with the Tubercle Bacilli in the later stages of lung disintegration ; Streptococci Pyogenes.

I.—THE ESSENTIAL MICRO-ORGANISMS OF PHTHISIS.

These are the Bacilli Tuberculosis or Tubercle Bacilli.

Since Koch's first description of the tubercle bacilli little has been added to our knowledge regarding their structure, morphology, and habits. Advances of the utmost importance have, however, been made concerning their chemical and chemico-physiological relationships.

Description of the Tubercle Bacilli (*3*).

They consist of rods 2 to 4, sometimes 8 microns in length, thin and rounded at the ends, sometimes perfectly straight, usually slightly curved and found singly, in pairs or in bundles. They often present a beaded appearance ; spore formation is observed in old cultures.

In giant cells they are often accompanied by grains which stain similarly to themselves.

They are non-motile, and thrive best at a temperature between 37° C and 40° C, though they have been cultivated at a temperature as low as 16° C (*4*).

Generally speaking the bacilli have a feeble energy of growth. Boiling kills them, though their spores are said to survive boiling, and indeed freezing temperatures.

Morphology.

They preserve a fairly uniform type in man, being usually longer than in cattle and fowls.

Chemico-Physiological Relationships (*5*).

From the bacilli have been isolated—(1) Ptomaines of distinctly alkaloidal properties. Indeed, two alkaloids have been separated in the form of platinum compounds of their hypochlorate salts. (2) Albumoses: these consist of proto-albumose, deutero-albumose, hetero-albumose, and dys-albumose. (3) Extractives, Mucin, Inorganic Salts, Glycerine, and colouring matters.

The Ptomaines when injected into a healthy animal produce a lowering of temperature.

The Albumoses when so injected produce a very marked lowering (*6*) of temperature. This reaction on the body temperature of healthy animals I consider very significant, showing, as it does, that there resides in the bacilli themselves a power which in lowering the (*6x*) temperature of the body lowers at the same time the vital and resisting power of the animal tissues. Whether this effect is brought about by the toxic bodies by an action on the great thermal centres, or whether it proceeds directly in all directions from the seat of inoculation, the result is the same, the toxins for the time being place the animal on a lower vital level.

Of the physiological effects of the other bodies extracted information is wanting.

The Rôle of the Bacilli in producing Phthisis.

These being the essential micro-organisms for the production of Phthisis the part played by them outstrips and overshadows all others. At the risk of inelegance of description I will again repeat Koch's doctrine already stated, viz., "Bacilli Tuberculosis are the sole cause of Phthisis; without their presence there can be no Phthisis."

How the Bacilli Enter the Body.

The micro-organisms enter the lymph or blood streams either by

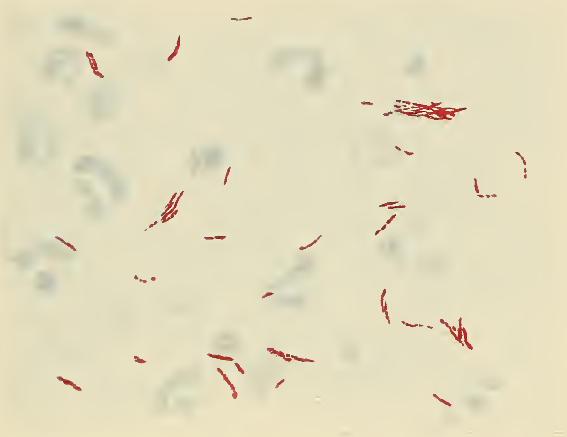
1. Inhalation. Hesse (*7*) has shown that the dust particles in the atmosphere often become laden with micro-organisms, including the tubercle bacillus; in this way the respiratory mucous membrane may give entrance to the bacilli.

2. The germs may enter through the mucous membrane of the alimentary tract through the use of infected meat (*8*), Milk (*9*), &c.

3. They may also enter the body directly through open wounds (*10*) or cuts.

4. Probably in man (certainly in calves) the bacilli may reach the body directly from a tubercular mother.

BACILLUS TUBERCULOSIS.



From a coverslip preparation of the sputa of a phthisical patient. The bacilli are stained red with Carbol-Fuchsin and the rinclei blue (Ziehl-Neelsen). Magnification, 850D. $^{1}/_{12}''$ oil imm: lens × ocular 4.

How the Bacilli reach the Lungs and Produce the Various Forms of Phthisis.

Koch's (*11*) conclusions from his microscopic examinations as to the relationship between the tubercle bacilli and the cellular elements of a tubercle nodule states : "The occurrence of one or two tubercle bacilli in cells of an epitheloid character must be regarded as the first step in the formation of a tubercle" He states that the tubercle bacilli, being themselves motionless, find their way to the lungs by carriage from the blood, lymph, or tissues, or from pre-existing tubercular foci in some other organ, by a wandering cell. The wandering cell, with its bacilli, may settle down in the pulmonary tissues and itself become an epitheloid cell, taking on giant cell characters, or the wandering cell may break down in its passage through the lung and discharge its bacilli, which get entangled in adjacent tissue cells. These then assume epitheloid cell and giant cell characters. Whatever may be the source of the original epitheloid cell, the cells in immediate contact with it soon take on epitheloid characters and soon encapsulate it. This rapidly enlarges by multiplication of its nucleus, and a giant cell is formed containing the bacilli. The individual bacillus is short lived, but its presence is maintained by the formation of spores and the successive generations which they give rise to. To this little epitheloid colony, with their living bacilli, surrounded by the escaped leucocytes and wandering tissue cells, which its presence has attracted, the name of "Tubercle Nodule" has been given.

Various fates may await the nodules at this stage, depending on the activity, or want of it, on the part of the bacilli they contain, and the local and general power inherent in the individual to resist the invasion of the micro-organisms.

1. Every bacillus and spore may disappear, and the only evidence of their visit will be the minute crater-like points of "coagulative necrosis" (Weigert) of the tubercular nodule surrounded by a minute zone of delicate connective tissue.

2. The nodules may remain in a state of quiescence, and give no evidence whatever of their presence till perhaps accidentally they are discovered when their host dies from some other disease. During this stage of quiescence it is reasonable to suppose that the bacilli are merely awaiting either an accession of inherent vitality on their own part, or a critical vital phase on the part of their host, when they will be enabled to successfully invade his tissues.

3. The bacilli may reach the lungs in such numbers, or in such a high degree of virulence, or at a time so opportune in the life-history of the host that scarcely are nodules complete ere they become the foci of areas of rapid lung disintegration.

THE IMPORTANT VARIETIES OF PHTHISIS.

(a) Chronic Phthisis.

In an ordinary case of Chronic Phthisis the disease proceeds as follows:—The tubercular nodules are formed, some in the alveoli, some scattered irregularly in the pulmonary tissues, chiefly selecting the apices. The nodules slowly increase in size, their centres undergo caseation, their periphery being bounded by a somewhat tough fibrous capsule. When close to an air passage they may discharge germ-laden and caseous contents into it. Or the nodule may suppurate, and pus, laden with bacilli, is then discharged. Now and then fragments of pulmonary tissues are coughed up with this mixture of pus and caseous material. Or a blood vessel may get eaten through, as it courses across a newly-made cavity or along its walls, when the sputum becomes tinged with blood, if a small, or marked hœmorrhage occurs, if a larger vessel be injured.

At this or at any earlier stage, though rarely at a later, the disease may totally disappear; more usually it goes on for years, till at length the patient gets worn out either by the Ptomaines, &c.; from the bacilli themselves, or through the absorption of the pus which has arisen during the morbid process. Frequently death results from an acute attack being super-added to this chronic process.

(b) Acute Phthisis.

This condition may be the result of:—

1. A tubercular invasion as indicated when describing the fate awaiting the tubercular nodules.

2. More (*12*) frequently it arises in the course of a chronic case of Phthisis in which the infected contents of a cavity on being expelled by some mischance falls back into a hitherto healthy air passage, when the lobe or lobule so menaced rapidly undergoes destruction, and large hœmorrhages results. The walls of a cavity so formed are ragged and ill defined, and are swarmed at the points of maximum destruction by legions of tubercle bacilli. Such a process is called caseous infiltration.

This varied combination of the two processes just described, that of a tubercular focus arising from a single centre of infection and extending slowly, and that of caseous infiltration resulting from saturation with the infective material, furnish the many-sided picture of disease of the lungs to which, according to Koch, the general name of Phthisis is given. The other form of Phthisis (so called) of various authors, are either other diseased states of the lungs with the tubercular process super-added, or are not tubercular at any stage, when the term Phthisis is, of course, totally misapplied.

Micro-Organisms Presumably Aiding the Tubercle Bacilli.

In a paper on "Infection and Immunity," Dr. Cartwright Wood (*13*) states :—"It has been proved to a demonstration that some micro-organisms accentuate the acuteness of a disease due to a different organism, also that the sterile products of some microbes exercise the same influence. Further, it is proven that some animals are apparently quite immune from the attack of some microbes, except when in the presence of another microbe or its products ; and it is shown that there are quite a number of different organisms which may combine to produce this "summative action." Equally, that the "power and potency" of action of other microbes clash, resulting in "dissipative action." It has also been shown that a bruise or anything abrogating the action of the living tissues render an animal susceptible to a disease from which it was otherwise immune.

Considerations such as the foregoing have suggested that possibly the tubercle bacilli have friends and foes. An Army Surgeon has opportunities for studying this side of the question better probably than any other, for he sees around him a certain constant and rather high rate of tubercular diseases of the lungs, and at the same time his patients often suffer from, or are exposed to, a variety of infectious and contagious diseases which rarely come under the observation of the general practitioner. It was therefore with some degree of hope that I entered upon an enquiry among my own experiences and those "mines" of facts, "The Army Medical" and "Registrar-Generals' Reports," with a view to find if in all the range of infective and contagious diseases the Tubercle Bacilli have really friends, foes, or both. To my infinite disappointment I find that a rather laborious search has furnished me with few positive and unchallengable facts (*14*). But some facts I did obtain, and they are these :—

1. There is no evidence that among the infectious and contagious diseases the Tubercle Bacilli have any foes.

2. They have one undoubted friend (*15*).
3. Of sympathisers they have many.
4. Many appear to be quite indifferent.

This brings me to Class II. of my classification.

1. Pfeiffer's Bacillus.

This is the one micro-organism which has undoubtedly aided the Tubercle Bacilli in raising the total volume, not only of Phthisis, but of all tubercular diseases since 1889 in civilian and military life, as may be seen on glancing at various tables in the Appendix.

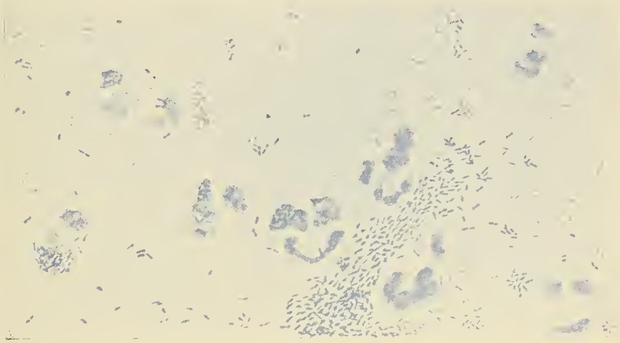
Description.

This bacillus was first discovered by Pfeiffer, and later on Bouchard (*16*) confirmed his work. These bacilli occur as short rods, singly or in leptothrix filaments. They are non-mobile and aerobic. They are found in the blood and bronchial secretions of those suffering from influenza. The bacilli, if applied to the respiratory mucous membrane of an ape, produce a disease identical to that in man. They are easily stained in aniline dyes. Whether Pfeiffer's bacilli play the friendly part towards the tubercle bacilli by joining him in a "summative action," as described by Dr. Cartwright Wood, or whether he acts by producing abrasions in the respiratory mucous membrane, through which the tubercle bacilli can enter, is uncertain. It is likely that he acts in both ways. It seems almost certain that by the profuse shedding of epithelial cells from the respiratory mucous membrane he must assist the tubercle bacilli to enter the pulmonary tissues. Other diseases assist in a similar way, and yet Phthisis does not increase in volume at the same rate in the absence of Pfeiffer's bacilli. The great rise in the amount of Phthisis during the pandemic of influenza beginning in 1890 must therefore in some degree be attributed to a direct "summative action" between the tubercle bacilli and Pfeiffer's. Further, since the pandemic has abated the amount of Phthisis has markedly decreased.

2. Plasmodium Malariae.

It will be seen from the considerations which follow that some most important relationships exist between the tubercle bacilli and the specific cause of Malarial Diseases, supposed to be due to the Plasmodium Malariae of Laveran. The writer considers that this relationship lies midway in importance between Pfeiffer's bacilli and

BACILLUS OF PFEIFFER.



From a Coverslip preparation of human nasal mucous. Stained by Loeffler's Methylene-blue (special method at 37°c).
Magnification, 1200D.

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the micro-organisms associated with the diseases enumerated in the next section.

From the very frequent association of high rates of Malarial Disease (*17*) and Phthisis the former disease deserves very special consideration in an enquiry like the present. For although the evidence does not justify the belief that Malarial Diseases constantly predisposes to Phthisis, yet the points of similarity and relationship of these diseases are so singular and suggestive that a brief account may be stated at this stage. The balance of evidence leads one to believe that in attributing Malarial Disease to the presence in the body of the Plasmodium Malariae, Laveran, Marchiafava, Celli, Sternburg, Manson, and others are right, notwithstanding the plausible quality of opposition from at least one Indian authority. Laveran (*18*) has described the Plasmodium Malaria as consisting some of minute, mobile, usually pigmented cylindrical elements with pointed extremities, others being crescentric or spherical, others again bearing mobile filaments as long as the diameter of a red blood corpuscle. Rosette and flagellated forms have been described by Golgi and Vandyke Carter. Laveran considers the hyaline variety he saw as only dead forms. In a recent number of the *Dietetic and Hygienic Gazette*, Dr. Memminger describes how that in Summerville, S.C., though situated in the "midst of a most deadly malarial country, and although the place is not more than two miles in diameter, the inhabitants are entirely free from Malarial Disease. Anyone spending even one night outside these limits greatly endangers his life. Yet hundreds come to Summerville even after considerable lung destruction has occurred, and, like the writer whose sputum swarmed with bacilli, left quite free of evidence of Phthisis. In short, like Malarial Disease, Tuberculosis cannot gain a footing in this area." It appears that some unknown natural preventive seems to be at work directed against these two diseases, and, as Dr. Memminger says, against no others.

Secondly, it is well known that Pulmonary complications in Malarial Disease usually, as in Phthisis, first select the apices of the lungs.

Again, it is also known that in Cuba, where Malarial Disease is almost neglected, a very high rate of deaths from Phthisis results. This was the case when the Spanish troops were stationed there.

From the foregoing facts it seems fairly clear that there is a relationship between Malarial Disease and Phthisis. But the evidence that Malarial Disease plays a part in the production of Phthisis is not so clear as in the case of Influenza, though probably more so than in the case of the diseases about to be mentioned.

3. Syphilis, Interic Fever (*19*), Measles, Scarlet Fever, Small-pox, Thrush, Diphtheria, Pneumonia, certain forms of Diarrhoea, Dysentry.

All are presumably depending on micro-organisms of some kind, make abrasions in the respiratory or alimentary mucous membranes, through which the tubercle bacilli are enabled to enter the blood or lymph streams. Not only do these diseases permit of the entrance of the bacilli, but the marked lowering of tissue vitality that ensues must undoubtedly favour the growth and advance of Tuberclulosis and Phthisis. Malarial and the "Other Continued Fevers" of the tropics may act in a similar way.

From the foregoing it appears that the sum total of these indirect effects of micro-organisms in the production of Phthisis may assume, especially in the British Army, very large proportions.

III. THOSE MICO-ORGANISMS ASSOCIATED WITH THE TUBERCLE BACILLI IN ADVANCED STAGES OF PHTHISIS.

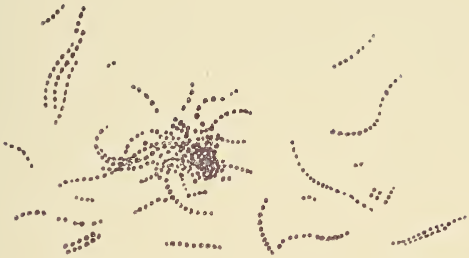
The Streptococci Pyogenes (*20*) are the micro-organisms coming under this head.

Description.

They occur as single cocci or in chains of globular immobile and sporeless cells. They are aerobic, thrive best at 37° C. They stain readily by Gram's method, and give very characteristic plate cultures. Some Continental observers attribute to the Streptococci Pyogenes a rôle of enormous importance in Phthisis.

It has been the subject of most painstaking enquiries by Cornet (*21*), Petrusky (*22*), and Babes (*23*). Whilst German clinicians have called the curve of Hectic fever the "Streptokken Curve," Sprengler, from a microscopic examination of 50 cases of Phthisis, declared that only a very small proportion of cases are uncomplicated, the vast majority

STREPTOCOCCUS PYOGENES.



From a coverslip preparation of a bouillon culture. Stained by Gram's method (Gentian violet). Magnification, $^1/_{12}''$ oil imm: lens × oc: 4 = 850 diams.

being cases of polymicrobic infection, the principle micro-organisms being the tubercle bacilli and streptococci pyogenes. He further declared that those cases of large cavity formation were especially rich in streptococci pyogenes.

These observations are in accord with the writer's. He has taken some trouble during the last seven years to enquire into this phase of the question, and feels convinced that in a great percentage of fatal cases of Phthisis the end is accelerated by the presence in the lungs of streptococci pyogenes.

The Determining of the Incidence of Phthisis.

Woodhead (*24*) says, "I do not think that a healthy person ever acquires tuberculosis"; also "an altered condition of health short of distinct disease may give the bacilli a footing."

The popular conviction is, therefore, that the tubercle bacilli cannot invade a healthy lung; that there must be some degree of antecedent dissolution of pulmonary tissues, some loss of vitality in the individual cells through local or general disease ere the bacilli can originate Phthisis.

The writer, whilst believing that the great majority of cases of Phthisis arise in the manner described by Woodhead, yet thinks that the power of the bacilli in preparing for themselves a nidus in which to start a primary tubercular process in a healthy man has been overlooked, and he submits the following considerations :—

1. The lowering of the temperature of a healthy animal, locally or generally, reduces (*25*) the vitality of its tissues.

2. The experiments of Herroun (*26*) and Crookshank have shown that the Ptomaines and Albumoses derived from the tubercle bacilli have the power of producing a marked lowering of the temperature of a healthy animal.

It is my belief that, provided the number of invading bacilli be great enough, an amount of Ptomaines and Albumoses may be thrown into the pulmonary tissues sufficient to create in a perfectly healthy lung the degree of antecedent devitalisation of tissue necessary for successful bacillary invasion. The cells nearest the bacilli are the first to suffer from such a lowering of vitality. A degradation of their complicated protoplasmic constitution ensues, resulting in the formation of simpler compounds from the more complex, and offering, therefore, to the tubercle bacilli a suitable nidus in which a primary tubercular focus may appear.

THE INFLUENCE OF MILITARY SERVICE UPON THE DISEASE.

Sydenham (*27*) says, "Fresh air in the open is as much a specific for Phthisis as bark is for ague, or mercury for Syphilis."

Nevertheless, whilst it appears on the surface that the duties of the soldier are performed as much in the open air as almost any other class, yet there is a higher rate of Phthisis generated in our army than in our civilian population, whilst in nearly all other great armies of the world the disease is more prevalent than in our own: vide chromatic chart.

In table 6 it is seen that the highest mortality from Phthisis among civilians in England, Wales, and London, occurs between the 25th and 35th year. Of the 99,360 (*28*) men of our own army serving in the United Kingdom in 1894 the ages of 25,213 fall between these years, whilst 67,865 fall below the 25th, and 6,282 are over their 35th year.

If the highest Phthisis rates occur at similar ages in military as in civil life, there must be amongst the 25,213 men a very decided high rate to account for the amount of disease shown to occur in 1894, whilst if the disease comes later in military than in civil life then the rates per 1,000 of cases occurring in the 6,282 men must be exceedingly high. If, on the other hand, the disease appears earlier in military than in civil life, then it is evident that not only does military service tend to increase the amount of disease generated, but actually hastens it. From every point of view it seems clear that the "Influence of Military Service" promotes the disease.

Again, Sir A. Tullock (*29*) and Dr. Balfour pointed out that whilst in the Equitable Assurance Company the mortality from Phthisis per 1,000 was only 3.4, the mortality at the same time (1830-36) in the Household Cavalry was 7.4; in the Cavalry of the Line, 5.29; in the Foot Guards, 10.8; giving the mean mortality per 1,000 as 7.83.

Tables (*30*) 1, 14, 16, 17, 18 also show that even so late as 1894 the disease is more prevalent in military than in civilian life in this country. The amount of Phthisis for which military service is responsible is in the writer's opinion far greater than is imagined. The brief phase of the soldier's life spent in the army affords but little opportunity for directly studying the extent of the disease acquired in it.

In the Health Report of the U.S.A. Army it is shown that in that country there is a very high death rate amongst the old soldiers from Phthisis. The same is stated to be the case in the French Army. Prior to entering the (*32*) Army the writer has had singular and exceptional opportunities during two years of witnessing in the post-mortem room the enormous prevalence of tubercular disease of the lungs amongst old soldiers.

In comparing the death ratio from Phthisis amongst civilians with that in the army, the writer wishes to point out that the numbers of cases of Phthisis annually invalided from our Army and Navy, as well as numbers of men who, though not invalided from the disease, yet retire with some degree of tuberculosis of the lungs, do much to swell the figures of the Registrar General's statistics. Furthermore, notwithstanding the great strides of sanitary progress in recent years—and sanitary progress has been earlier and more vigorously at work in British military than in civil life—yet the Phthisis rate, though fallen in the Army, has not fallen in proportion to the decline of the disease amongst civilians (*33*).

From the foregoing facts and considerations the writer submits that :—

1. The "Influence of Military Service" is such as to cause a higher rate of Phthisis amongst soldiers than would have occurred had they remained civilians.

2. That whatever these influences are, though somewhat lessened by army sanitary reformers, yet sanitary reforms have not gone far enough to remove those already recognised, whilst others have remained quite untouched, probably because they were considered trivial, or perhaps not known to exist.

In all the literature relating to Phthisis in military life—and the writer has ransacked the great scientific libraries in Paris and London—there is, he submits, nothing comparable to the article on "The Influence of Military Service on Tubercular Disease" in Parke's Hygiene (*34*) (edited by Notter), either for closeness of reasoning, the careful arrangement of facts, or brevity of description.

To enter upon the study of this subject without reference to this Article, and others in the volume mentioned, is like visiting Egypt and ignoring the Pyramids. The writer, while he believes he can add substantially to the subject, yet in justice to it feels bound to use some of the facts and conclusions in the volume referred to.

At the outset, the writer wishes to point out that the comparisons formerly made between the amount of Phthisis in the civilian population and in the army rested upon observing the death-rates from the disease. Now, the death-rate in one year amongst civilians plus the very few cases sent abroad for cure, and minus the Phthisical invalids and others who annually leave the army and navy to join the civilian classes, fairly represents the number of Phthisical cases annually occurring in these classes. The writer believes that a truer conception of the state of affairs will be arrived at if, instead of comparing the death-rate in the army with the death-rate among civilians, we compare the admission-rate of the former with the death-rate in the latter, and for these reasons :—

The "deaths" only include about one-half of the cases of Phthisis occuring annually in the army, numbers being invalided into civilian life, whilst probably many cases of incipient Phthisis manage to serve their term of years, after which they join the civilian population. Probably there are few diseases in Military Hospitals with which more care is exercised in diagnosing than Phthisis ; so that the admission-rate must fairly accurately represent the amount of Phthisis in any one year.

It might appear at first sight that the death plus invaliding-rate would be the better guide. This is not so, as many are admitted with undoubted Phthisis, who either recover altogether or sufficiently to enable them to serve their time. From these considerations the writer submits that he is justified in using the admissions for Phthisis in the various armies for comparison *inter se* and our own army with our civilian population.

With a view to make this section ("The Influence of Military Service on the Disease") as valuable as possible I have set forth in the Appendix, amongst others, certain tables showing the following facts :—

1. In Table 1 the death-rate in England (*35*) and Wales from (1) Phthisis ; (2) all Tubercular Diseases (including Phthisis) in ratio per 1000 of males living during the years from 1875 to 1894 inclusive.

2. In Table 6 the deaths from Phthisis and "all Tubercular" Diseases in England (*36*), Wales, and London in ratio per 1000 of males living, and at various ages.

3. In Table and Chart, page 33, the ages at which Phthisis and all Tubercular Diseases prove most fatal amongst civilians in England and London.

4. In Tables 7, 8, 9, 10 the average strength, the death-rate, and average age at death from Phthisis amongst the male officials of the Post Office (*38*) throughout England, Scotland, and Ireland.

5. In Table 14, dealing with the British army. (1) The total (*39*) deaths from all causes; (2) Admissions, deaths, and invalids (sent home) from Tubercular Diseases during 1894 in ratio per 1000 of strength, and also the average annual ratios dealing with the points for the octennial period preceding that year.

6. In Table 15 a comparison (*40*) may be made as regards the prevalence of Phthisis in the Post Office Staff (male) and Tubercular Diseases in our own Army and Navy.

7. In Table 36 the General death-rate from all causes in ratio per 1000 of total population of the various countries named, and the admission and death-rate from Tubercular Diseases per 1000 of strength in our own Army during 1894 and preceding octennial period, with the admission and death-rates from Phthisis in ratios per 1000 of mean strength for 1893 or 1894, and also for various periods in the various armies named.

8. In Tables 19 to 35, and W, X, Y, Z, kindly sent me by the military authorities of the various countries (*41*), statistics relating to Phthisis are seen.

9. In Table 37 the statistics relative to the navies named are contrasted.

10. Finally the whole Appendix is briefly reviewed.

The evidences my enquiries have brought together would, were it necessary, of themselves prove that military service is associated with a high prevalence of Phthisis in communities of what must be considered as select lives; and they suggest that were the strain of military influences thrown on other than select lives the result would be disastrous.

Sad though the facts are which are known to exist, sadder still is it to contemplate that, as the writer most sincerely believes, we do not, nor can we know one-half of the suffering or deaths from Phthisis due to the influences at work in military service in this and other countries.

Coming to closer quarters with the subject the writer wishes to point out that the general opinion of the experts (*42*), expressed before the Royal Commission on Tuberculosis lately published, was that but a very small proportion of tubercular diseases generally, and Phthisis in particular, was contracted by way of using tubercular meat or infected milk. It is probable that a smaller amount of tubercular disease is in this way contracted in the army;—even though the army did suffer in this way it could hardly be said to suffer from an influence associated only with it.

It is here considered best to deal with those "Influences of Military Service" which fall under the following heads.

(a) Those influences damaging the lines of defence of, and, the respiratory mucous membrane and pulmonary tissues of the soldier.

(b) Those damaging his general health. To some degree the second group includes the first. The writer considers that the following are the various influences inseparable from the life of the soldier during some part of, or during the whole of his service, and in the order of their importance as favouring the incidence of Phthisis in our own army—(1) Overcrowding; (2) Military Training and Exercises as carried out; (3) Dampness; (4) Dust; (5) Foreign Service.

Although in the article referred to in Parke's Hygiene, Lawson's suggestion that "chills" play an important part in the production of Phthisis is sympathetically considered, yet it is evident that the writer of the article believed that "overcrowding," and this alone, was the cause of the disease being more prevalent in the army than amongst civilians.

Certainly in former years overcrowding was undoubtedly the main cause of the high rate of Phthisis—possibly it is so to-day—but in the opinion of the writer there are other causes, more difficult to prevent, which approach it very closely in importance as influencing factors.

In proof of the statement that overcrowding does increase the death-rate from Phthisis I must (1) quote the results of an enquiry held by Drs. Carnelly (*43*), Haldane, and Anderson, of Dundee, who found that in houses of 4 rooms the death-ratio per 1000 was 3.2, in houses of 3 rooms the death-ratio per 1000 was 5.52, in houses of 2 rooms the death-ratio per 1000 was 6.44, in houses of 1 room the death-ratio per 1000 was 7.44. (2) In Vienna (*44*) the death-rate per 1000 from the disease in a badly ventilated prison was as high as 51.4 per 1000, whilst at the same time, in the same city, in another well-ventilated prison the death-rate from Phthisis was 14 per 1000. (3) The Report (*45*) of the Royal Commission in 1885 showed that there was overcrowding in the case of the Foot Guards, and that this was the cause of the high death-rate from Phthisis amongst the men compared with that in the city generally. (4) The diminished amount of the disease amongst the Foot Guards after better ventilation was established shows that overcrowding was a potent factor in producing the disease. (5) The fact that in badly ventilated ships

(*46*) the death-rate from Phthisis was high, and low in well-ventilated ships in the same years and in the same waters shows that overcrowding is an undoubted influence in favouring the disease.

I. How Overcrowding Increases the Disease.

1. By lowering the vitality of, or producing actual disease in, the "lines of defence" (Woodhead *47*) of the lungs (Lymphoid tissues in tonsils, soft palate, and around larynx). These conditions are doubtless brought about by the carbonic acid, ammonia, aqueous vapours, and extractives, all of which have a distinctive depressing (*48*) effect on the vitality of epithelial tissues, and especially on the ciliated epithelial cells, and they are all present in overcrowded rooms.

2. The atmosphere in an overcrowded room is often a source of direct infection. In a barrack containing say 800 men the chances are that at least there will be 3 men suffering from some degree of tubercular disease of the lungs. If the rooms were thoroughly ventilated the chances of the bacilli remaining indoors would be far less than if badly ventilated. Under the latter condition, therefore, infection of the healthy men subjected to the foul and depressing atmosphere would occur.

3. The foul air acts indirectly by debilitating, to some degree, every man subjected to it, and to that extent favours bacillary invasion.

II. Military Training and Exercises as at present carried out.

It may seem hazardous to oppose the popular belief that Military Training, having so many good effects on most soldiers, cannot in any sense in any individual tend to produce Phthisis. It does so. I submit by (1) injuring, in some, the surface of the lungs; (2) by injuring to some degree, probably in all, the interior of these organs.

When we consider that in our own army though most recruits are obtained at their 18th or 19th years (*49*), yet large numbers are recruited at greater ages, and at the age of 24 and 25 no fewer than 1105 are enlisted. For the purpose of my argument it is only asked that these 1105 men be kept in view.

Now, these men are, as a popular living poet says, (*50*) "Taken from the workshop and the plough," their previous occupations (and by far the most of them have had previous laborious work or trades) have, up to their enlistment, been the environments which have been the force at work in shaping the spinal curves and chest conformation, and following this the position occupied by their lungs, &c. What number of these men may have had small pleural adhesions, or former patches of slight pulmonary inflammation, which in civilian life would be harmless, it is difficult to say. We may reasonably assume a certain amount of such previous disease to have existed. Now, one of the main objects of military training is to teach the recruit the correct position of the soldier, whether at the halt or on the move, and I hold that in a considerable percentage of cases, bearing in mind the previous considerations, it is reasonable to believe that some damage results to the surface of the lungs by the various drills and duties inseparable from a soldier's life of the present day. Of course in the case of the young recruit such injuries, while possibly occurring, are less likely than in the case of the older.

2. The lungs are injured internally by military training and exercises, probably in all.

In order to explain the manner in which this is done a few physiological facts connected with respiration may be recalled to memory.

1. There are 100 cubic inches of "Residual Air" in the lungs after the deepest expiration (*51*).

2. There are in the lungs after an ordinary expiration 100 cubic inches of air, in addition to the residual air, called the "Supplemental Air." 30 cubic inches of air are taken into the lungs with each ordinary inspiration and expelled during each ordinary expiration—this is the "Tidal Air." So that in ordinary respiration there are 200 cubic inches of air in the lungs and 30 cubic inches of "Tidal Air" coming and going. Finally, by a very deep and prolonged inspiration, it is possible to introduce 100 cubic inches more, called the "Complemental Air." After the deepest inspiration there are, therefore, in the lungs 330 cubic inches of air, which number expresses the "maximum capacity of the chest."

The writer has gone into this matter with care, both in London and elsewhere, and from his observations he finds that the position of the soldier's chest, and the quality of his respiratory movement must frequently and necessarily tend to bring about the condition of "maximum chest capacity." This condition is not fully brought about owing to the pressure of jackets, waist, and often other belts, corsets, &c. The result being that the intra-vesicular and intra-infundibular air-pressure is highest in the apices. From such a "respiratory habit" the lungs are (1) mechanically impaired by the loss or weakening of the elastic recoil of the pulmonary tissues, and minute ruptures may occur in the mucous membrane ; (2) Chemically impaired by the temporary interruption of the natural rate of intrapulmonary gaseous diffusion ; and the basis probably suffer, in addition, from pressure and defective capillary circulation.

With such injuries to the lungs (and the writer is convinced that they must often occur in this country and in France) it does not appear strange that the Bacilli Tuberculosis finds an easy entrance; and, in the writer's opinion, it speaks well for the vigour of the British soldier, while serving, that Phthisis does not appear oftener.

III. Dampness.

As an influence productive of Phthisis, in the army and elsewhere, the writer produces the following evidence :—

1. Dr. Georgiefski (52), in an article in the *Vratch*, June 1895, states that in the Russian Army Phthisis is far more prevalent in the damp north-western districts.

2. M. le Médecin, Inspecteur Genéral Dujardin-Beaumetz, of the French Army, informs me that by far the great majority of cases of Phthisis occur in the damp Departments of Brittany and Normandy.

3. Colonel Spigler, the médecin en chef of the Federal Army of Switzerland, informs me that he partly attributes Phthisis in the Army to damp clothes, which bring out the disease that otherwise would remain latent.

4. The general high death rate from Phthisis in the damper districts of Ireland, and that shown on Tables 7, 8, 9, 10, referring to the death rates among the Post Office Staff (male) connects a damp atmosphere and wet clothes with the disease.

5. Dr. Alfred Havilland (53), in "Geographical Distribution of Disease in England," shows that Phthisis is most prevalent in damp areas.

6. Buchanan (54), shows that in damp, ill-drained localities, there is usually a high death rate from Phthisis which disappears when drainage is properly established.

Conditions of Dampness to which Military Service Exposes the Soldier, and how it Acts.

1. Damp clothes, Catarrhs, Bronchitis, Tonsillitis, Pleurisy, Pneumonia, often arise from the soldier having, in the course of his duty, to wear damp clothes, all of which are distinctly favourable for

the super-addition of Phthisis. Indeed, as Colonel Spigler suggests, it seems that a feeble bacillary invasion may in this way assume a degree of virulence which directly determines the disease.

2. Damp Soils.—These act (1) By favouring the permanent residence of the Tubercle Bacilli in a locality. (2). By keeping the atmosphere near the earth laden with aqueous vapour and impure emanations from the soil. (3). By inducing catarrhs and other diseases promoting Tuberculosis.

3. Damp Atmosphere.—This induces Phthisis by impairing the vitality of the general respiratory mucous membrane, especially the (*55*) ciliated cells. Probably also by interfering with general nutrition of the body by deranging the normal rate of excretions from the skin, etc.

Dampness in some form or another is invariably associated with military service in the United Kingdom, and it has been shown that it does promote Phthisis, and an endeavour has been made to point out some of the ways it may act in doing so.

IV.—Dust.

The mortality (*56*), from Phthisis in certain dust-producing trades, as compared with the mortality in England and Wales generally, is shown in the following Table, the deaths from all cases in Wales being taken at 1000 :—

All Males (England and Wales)	220
Earthenware Manufacturers	473
File Makers	433
Miners (Cornwall)	690
Printers	461

Hesse (*57*) and Tyndal (*58*) have shown that the ærial dust particles are frequently laden with micro-organisms, and that the Tubercle Bacilli are often so suspended.

The dust also acts mechanically by injuring the respiratory mucous membrane, or in producing Bronchitis, etc., on which Phthisis supervenes.

Now, the movements of the men in close order during military training and exercises, necessitates the contamination by dust of the atmosphere around them, either on the parade ground or during route and other marching.

Again, "be the home ever so humble," the recruit on first quitting it enters a dustier one on reaching the barrack-room.

From these considerations the writer feels convinced that dust plays some part in the life of the soldier, rendering him more liable to Phthisis.

V. Foreign Service,

and the Tropical Diseases acquired by the British soldier do something to break down his resisting power, so that whilst abroad, or on his return home, he becomes an easier prey to the Tubercle Bacilli than he would have been had he remained a civilian. There may yet appear clearer evidence that the malarial diseases are in some way closely associated with Tuberculosis, and here the writer suggests that the full effects of Tropical Climates are not yet known, as the rigorous training, etc., of the British soldier is not yet insisted upon abroad. If it were insisted upon, very probably a higher rate of Phthisis would prevail.

As regards the influences at work among our own Household Troops in producing the highest rates of Phthisis in our army, it may be pointed out that:—

1. The drills are carried out with exceptional exactitude, and with a rigour that certainly borders on excess.

2. The principal barracks occupied by the Foot Guards, Wellington and Chelsea, are only a couple of feet above the high-water level of the Thames; they rest on wet clay foundations, and till quite recently suffered from a quality of drainage that did little credit for those responsible for its construction.

3. The early hours chosen for the parades, 7 a.m. or earlier in the summer, 8 a.m. or earlier in the winter (when the sun's rays can have done nothing or little to dry or warm the atmosphere, or exert its well-known germicidal action), must be favourable to bacillary infection. Besides, the guard duties of the Foot Guards entail much exposure to damp and cold during the winter which are not to the same extent experienced by any other troops in this country.

4. It is probable that in the case of the Cavalry troops, who sleep over their horses, this circumstance may act as an evil influencing factor.

5. It may not be amiss to state that in cities like London and Paris "fast living" is common amongst the men: debilitated health results; and this fact must exercise some influence in the production

of the higher rates of Phthisis in the troops quartered in these large cities.

These five causes (severe drilling, barracks on bad sites and badly drained; too early parades and heavy guard duties; proximity of men's barrack rooms to their horses, in the case of the Cavalry; the fast living so common among young soldiers in London) to my mind are the additional factors at work in keeping up the excess of Phthisis in the Household Troops over the Army in general.

Suggestions for the Prevention of Phthisis in the Army.

To prevent Phthisis in the Army our efforts must be directed against :—

I. The Micro-organisms causing the disease, viz., the Tubercle Bacilli.

II. The "Influences" military, and other known to favour Phthisis.

I. If During the next 45 years the fall in the death-rate from Phthisis in this country be as great as it has been during the 20 years preceding 1894, the disease will cease to bear any formidable ratio per thousand of the population.

Till then, however, we must

1. Exclude from the Army all who have any sign, symptom, or even suspiciousness of Phthisis. This is, I hold, being done, as far as possible, at present, in the most carefully recruited army in Europe, viz. : the British,

2. At Depôts recruits should be weighed fortnightly. Men found losing weight should be kept in an "observation" barrack-room and their drills curtailed, and, if the loss of weight continues, which cannot be accounted for, together with alteration of the breath-sounds—suggestive of the "pre-tubercular stage" of Phthisis—the man should be invalided at the end of 3 months, even though no tubercle bacilli be found.

3. In Inspection rooms in barracks or hospitals there should be—as there is in the writer's—a rapid and simple method of examining the sputum from the handkerchiefs of men suffering from chronic catarrh.

Men suffering from chronic catarrh should be weighed fortnightly and their sputum examined. Should tubercle bacilli appear, or loss of weight continue, such cases should at once go to hospital for treatment or further observation and action.

4. Phthisis being an infectious* disease, there should be in Military Hospitals well ventilated and lighted wards (facing the south, if possible), set apart for

(*a*) Doubtful Cases of Phthisis.

(*b*) Undoubted Cases.

5. In Military Hospitals the following precautions should be taken :—

(*a*) Men allowed " up " should be compelled to spit into the fire or into spittoons charged with sawdust or sand saturated with a 5 p.c. solution of carbolic acid, or, they might be provided with Japanese paper handkerchiefs, which should be instantly burnt.

(*b*) Men confined to bed might use the paper handkerchiefs or spittoons.

(*c*) The clothing of all tubercular cases should be thoroughly disinfected in a solution of corrosive sublimate (1 in 1000) and their pocket-handkerchiefs should be burnt.

(*d*) The bedding of phthisical cases dying, invalided, or discharged to duty, should be thoroughly disinfected.

(*e*) The floors, tables, etc., should be washed weekly with a solution of corrosive sublimate (1 in 1000).

(*f*) Dishes, spoons, etc., should be kept specially for use in these wards only.

6. In Depôts, Barracks, General Wards in Hospitals, and on board ship, spitting elsewhere than in spittons specially charged with antiseptics, should be considered as committing a nuisance and dealt with accordingly.

7. In Depôts and Barracks the floors should be once a week sprinkled over with sawdust or sand saturated in a 5 p.c. solution of carbolic acid, or other suitable antiseptic, and carefully swept after lying a couple of hours.

8. The Milk and Meat supply should be placed under the direct control of an Officer of the Army Medical Department, who might be appointed the Sanitary Officer of the Station.

He should be vested with the following powers :—

(*a*) To visit dairies, cowsheds, and milk-men, wherever the milk supply is obtained, and to stop the supply if he considered it dangerous.

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* Indeed, Phthisis is actually classified amongst the ship "Infective Diseases" in the Health Report of United States Navy for *1896*, p. 67, *etseq.* (Just to hand, 29th December, 1896).

(*b*) To inspect the meat supplied to the troops, and to order the destruction of the whole or any part of a carcase which he may consider unfit for use.

(*c*) To supervise the cooking of the meat supply, and to insist that meat for roasting be cut into pieces not exceeding 4 lbs. in weight, which, according to Woodhead's experiments (detailed before the Royal Commission), is the maximum weight consistent with complete sterilisation by roasting.

II. Those "Influences," military and other known to favour Phthisis.

I would suggest that :—

(a) The authorised allowance of cubic space for men in barracks be increased from 600 cubic feet to 700 cubic feet for the Line, and 800 cubic feet for the Household troops. The respiratory capacity ot the latter, their volume, the position of their barracks, and the nature of their duties compel me to plead for additional cubic space for these troops.

(b) The Officer in Medical Charge of Troops should annually instruct the N. C. Officers as to the necessity for fresh air, and the means of maintaining it in the barrack-rooms.

(c) The Officer Commanding units should be instructed to issue orders to the N. C. Officers as to the ventilation of barrack-rooms by day and night. Failure to comply with such orders ought to be rigorously punished.

To illustrate the necessity in carrying out suggestion C. the writer will briefly relate a personal experience. It was his habit to visit the barrack-rooms at 12 midnight on Sundays, with a view to see to the state of ventilation. After a few weeks of this nightly inspection, all seemed to go well. It occurred to him, however, that possibly he was expected to visit always at that hour and day, so on one occasion he paid another visit at 2 a.m., and to his disgust found the windows in several rooms shut!

This experience deeply impressed him of the futility of issuing orders without means of punishing the offenders.

(d) Overcrowding on the parade-ground and on the march should be carefully avoided. To some extent this is being done at present, but the writer would suggest that the distance observed in "open order" should be further increased.

(e) The greatest care should be taken that the barrack-rooms be thoroughly lighted, as light, especially the direct sun-light, has decided germicidal powers.

2. Drills and Exercises.—I would suggest that :—

(a) The belts and all articles of equipment of the soldier be reduced in weight.

(*b*) Tight belts of all kinds, tight jackets, tunics, trousers and corsets, should be dealt with as an offence.

It is difficult to comprehend the fatuity of purpose which has led the military authorities in most European armies to encase the body of the soldier in a crustacean-like exoskeleton, when we consider with what a highly evolutionised respiratory system Nature has endowed him. I submit that to such a state of affairs the army sanitary reformer must ever remain hostile, for so long as this flagrant breach of Nature's designs continue, so long will Phthisis be the chief penalty exacted.

(*c*) The drills and exercises of the recruit should be less severe the first month of his training.

(*d*) All drills should be fewer throughout the Service, and the "Stand easy," should come oftener.

(*e*) In this country they should not take place earlier than 9 a.m. in winter and 8 a.m. in the summer.

(*f*) Boxing, swimming, and racing should be made compulsory for all, for reasons these exercises suggest.

3. Dampness.

(*a*) The barracks should occupy, as far as possible, sites in sheltered positions, with high, and dry foundations, preferably red sandstone, or the nearest approach to this. The greatest care should be taken to have the barrack areas and parade grounds thoroughly drained.

(*b*) When possible, parades should be avoided during the damp, foggy hours of the day, if any such exist, and, as before suggested, early parades should also be forbidden.

(*c*) A drying apparatus should be provided in each barrack for the damp clothes of the men.

4. Dust.—In regard to this I would suggest that :—

(a) Far more care should be taken in dusting the barrack rooms, libraries, canteens, etc

(b) A more "open order" should be observed in marching, etc.

5. Foreign Service.—I would suggest :—

(a) The men selected for foreign service should be older than at present.

(b) Sanitaria ought to be more plentifully provided in India and other tropical stations for convalescents from all diseases.

(c) Sanitaria should be built at high altitudes for phthisical cases. Many cases would make a perfect recovery, whilst the sufferings of others would certainly be ameliorated.

Finally, the fact may be recalled that man, in a state of health, is a highly refractory animal to the tubercle bacilli. These again can only exist outside an animal body in artificial media ; in insanitary surroundings, such as dark damp dwellings, damp subsoils, or in an atmosphere polluted with impurities from the animal and vegetable kingdoms.

In this Section the writer has endeavoured to point out the steps necessary to be taken in the Army to prevent Phthisis entering it, or having entered, to prevent the healthy from becoming phthisical by infection from the diseased : he has also tried to indicate the reforms which in the military service are necessary, if we are to remove the influences favouring the disease. Last of all, the writer submits that all his suggestions are within the limits of what it is possible to do for the British soldier.

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BRITISH ARMY.

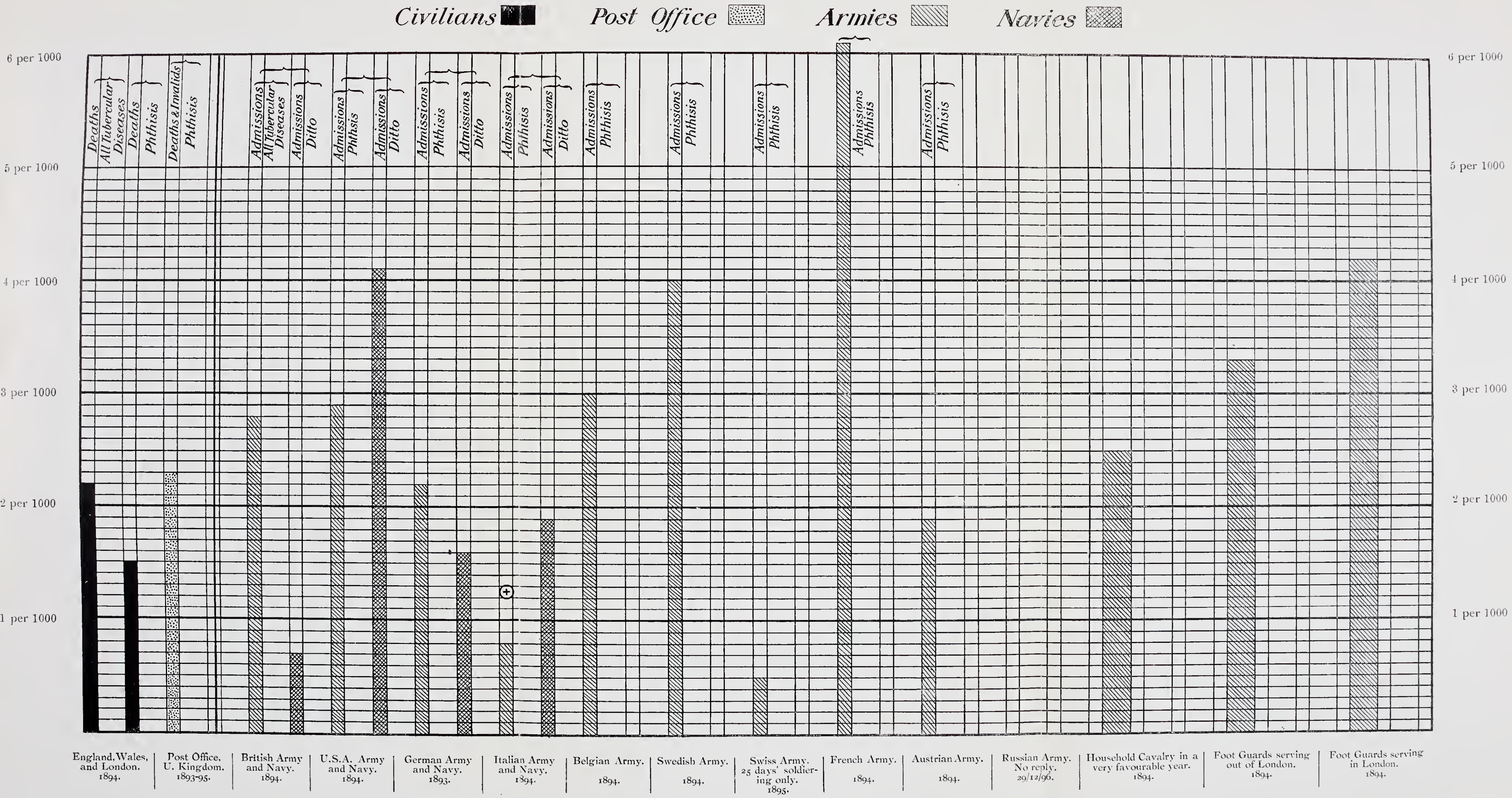
* Table showing admissions from Tubercular Diseases in the eight areas of greatest prevalence during 1894 and previous octennial period, and contrasting these admissions with those from Diseases of the Respiratory System, and with those depending for their origin on micro-organisms or their poisons, which are most prevalent in the Army in the same areas.

DISEASES.	UNITED KINGDOM.		CHINA.		CEYLON.		INDIA.		W. INDIES. White Troops.		STRAITS SETTLEM'TS.		W. INDIES. Black Troops.		W. AFRICA. Black Troops.	
	Ratios per 1000.		Ratios per 1000.		Ratios per 1000.		Ratios per 1000.		Ratios per 1000.		Ratios per 1000.		Ratios per 1000.		Ratios per 1000.	
	1894.	86-93.	1894.	86-93.	1894.	86-93.	1894.	86-93.	1894.	86-93.	1894.	86-93.	1894.	86-93.	1894.	86-93.
Tubercular Diseases	3.2	4·0	3·4	4·5	3·5	3·6	3·6	3·4	5·2	1·3	4·6	1·8	12·9	7·7	7·0	10·4
Diseases of Respiratory System	44·5	76·8	32·5	28·1	34·0	25·4	46·4	30·9	20·9	30·9	14·4	23·8	49·6	52·3	66·8	62·4
Malarial Fevers	5·0	7·0	453·7	458·3	53·2	34·3	379·6	326·7	38·2	43·4	29·6	126·4	44·0	106·9	567·4	907·1
Secondary Syphilis	34·8	41·6	67·8	44·3	58·8	55·1	80·8	51·3	45·6	37·2	104·0	92·3	51·5	46·5	41·0	49·1
Other Eruptive Fevers ...	7·8	9·2	·7	—	5·7	·3	1·6	1·7	—	5·5	—	·2	8·8	14·5	—	3·5
Enteric Fever	1·3	1·5	—	1·2	33·3	9·1	18·4	15·5	9·7	10·7	—	3·1	1·3	3·5	—	·6
Other Continued Fevers ..	2·6	5·9	2·8	11·8	—	69·5	21·6	66·7	222·9	92·7	77·4	70·0	97·9	108·8	—	8·1
Dysentery	·4	·8	18·0	13·7	17·0	20·5	48·6	31·9	3·7	7·0	6·1	8·1	13·8	13·5	7·0	22·2
	8·6	11·0	90·0	88·2	28·0	31·4	91·7	82·3	53·3	32·7	36·1	50·0	36·2	48·9	102·5	165·1

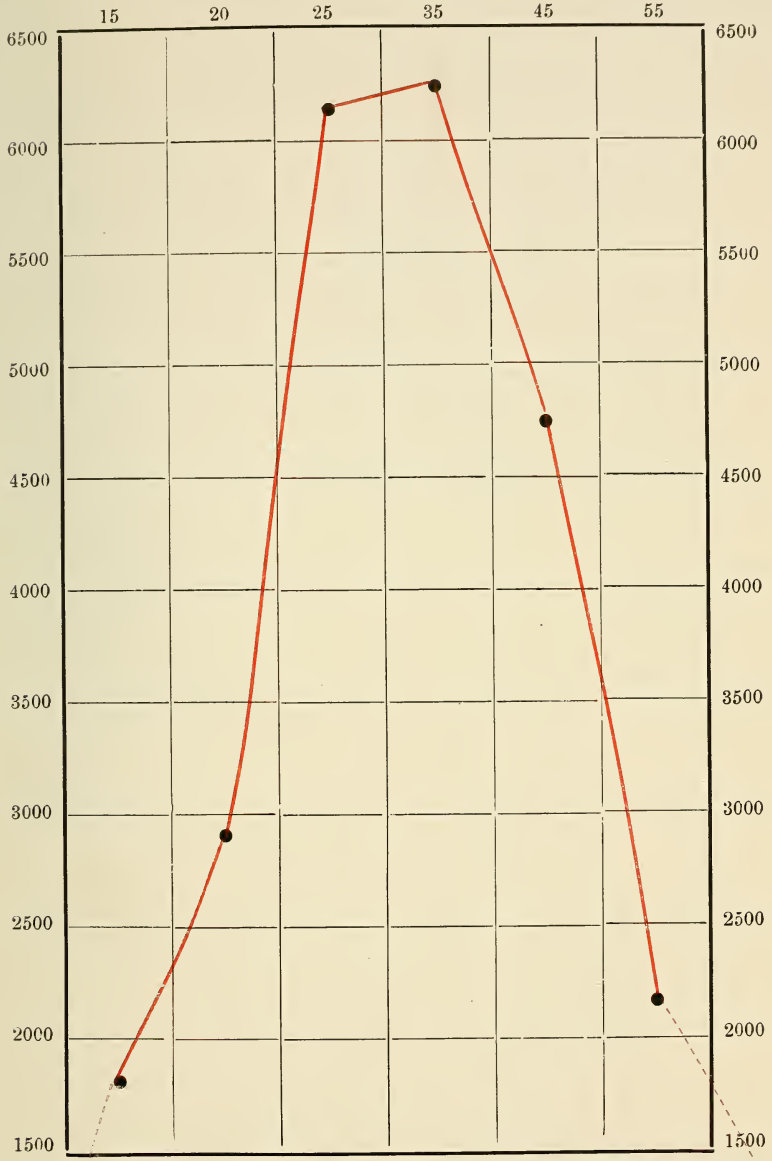
* Supplied from statistics in the Director General's Report for 1894.

Chart showing by Deaths or Admissions the relative prevalence of Phthisis or Tubercular Disease in the Civilian Population, and Males in Post Office Staff of United Kingdom, with the various Armies and Navies named.

+ The column for Italy should be about ⅓ higher, as those men sent to Civilian Hospitals are not reckoned officially.



* Table and graphic-wave demonstration of Deaths from Phthisis in Males of various ages in England, Wales, and London, in 1894.



Phthisis	1777	2939	6256	6361	4756	2496	Phthisis
All Tubercular Diseases	3250	3250	6690	6658	4973	2624	All Tubercular Diseases

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* Supplied from Calculations based on Registrar-General's Statistics for 1894, page 114 *et seq.*

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25. Same as *6x*.
26. Same as *6*,
27. Syd. Soc. Trans., Vol. ii., page 107.
27x. Registrar General's Report 1894, page 144, *et. seq.*
28. A.M.D. Report, 1894.
29. Parke's Hygiene, page 584.
30. From Sources named under each Table.
31. Parke's Hygiene, page 584 (*d*),
32. Pathologist to large institution.

33. *Vide* Appendix, table 1.
34. Parke's Hygiene, page 582.
35. *Vide* Appendix.
36. *Vide* Appendix.
37. Registrar General's Report, 1894, page 144, *et seq.*
38. *Vide* Appendix.
39. A.M.D. Report, 1894, page 184, *et seq.*
40. *Vide* Appendix.
41. *Vide* Appendix.
42. Woodhead, Goodhart, Ransome, Littlejohn, Horsley, etc., etc.
43, 44, 45, 46. Parke's Hygiene, pages 168-169.
47. Lecture by Woodhead, *vide* 8.
48. General Physiol. by M‘Kendrick, page 491 and elsewhere.
49. A.M.D. Report, page 31.
50. Rudyard Kipling.
51. Special Physiol. by M‘Kendrick, page 321.
52. *British Medical Journal.* April 27th, 1895.
53. Page 39 *et seq.* of work quoted.
54. Report to Privy Council, 1867.
55. Same as *48*.
56. Parke's Hygiene, page 160.
57. Same as *7*.
58. " New Fragments of Science," by Tyndal.

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England and Wales.

* Table 1, showing death-rate in Males from "Phthisis" and "All Tubercular Diseases" in England and Wales, in ratios per 1000 of Males living during 20 years ending 1894.

Year.	Phthisis	All Tubercular Diseases.	
1875	2·29	3·18	Ratio per 1000 of Males Living.
1876	2·22	3·05	,, ,, ,, ,,
1877	2·17	3·04	,, ,, ,, ,,
1878	2·21	3·13	,, ,, ,, ,,
1879	2·14	2·97	,, ,, ,, ,,
1880	1·93	2·87	,, ,, ,, ,,
1881	1·92	2·71	,, ,, ,, ,,
1882	1·94	2·77	,, ,, ,, ,,
1883	1·96	2·75	,, ,, ,, ,,
1884	1·92	2·75	,, ,, ,, ,,
1885	1·87	2·61	,, ,, ,, ,,
1886	1·87	2·69	,, ,, ,, ,,
1887	1·72	2·47	,, ,, ,, ,,
1888	1·71	2·44	,, ,, ,, ,,
1889	1·71	2·47	,, ,, ,, ,,
1890	1·86	2·64	,, ,, ,, ,,
1891	1·78	2·56	,, ,, ,, ,,
1892	1·62	2·36	,, ,, ,, ,,
1893	1·63	2·38	,, ,, ,, ,,
1894	1·56	2·2	,, ,, ,, ,,

* Table 2, showing death-rate in England and Wales from "Phthisis" in Males, in ratio per 1000 of those living in 1894, and in average annual ratio of those living during the period 1884-93.

Year.	Phthisis.	
1894	1·56	Rate per 1000 of Males Living.
1884-93	1·77	,, ,, ,, ,,

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* Supplied from Registrar-General's Report for 1894, page 53.

* Table 3, showing Deaths from 15 of the most prevalent causes in England, Wales, and London, in ratio per 1000 dying.

Bronchitis	98·94
Phthisis	83·47
Pneumonia	65·30
Other Diseases of Circulation	62·15
Old Age	49·14
Cancer	42·94
Debility, Atrophy, and Inanition	36·64
Convulsions	36·33
Apoplexy	32·27
Premature Birth	31·74
Whooping Cough	24·76
Measles	23·56
Diarrhœa and Dysentry	21·07
Endo-carditis	18·67
Diphtheria	17·58

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* Table 4, showing Deaths from all Tubercular Diseases to 1000 Deaths from a l causes.

Phthisis	83·47
Tubercular Meningitis	12·72
Tabes Mesenterica	11·55
Other Forms of Tuberculosis	11·13
Total ..	118·87

Supplied from Registrar-General's (for England) Report, 1894, page 33.

*Table 5, showing Deaths "per Million living" in England and Wales attributed to Influenza and Diseases of Respiratory Organs during the 6 years 1889-94.

RATE PER MILLION LIVING IN EACH YEAR.

Distribution.	1889	1890	1891	1892	1893	1894	Mean 1890-94
London, ...	3683	5059	5851	5062	4914	3507	4879
Southern Counties, ...	2445	3168	3687	4160	2955	2794	3353
Northern Counties, ...	3844	4819	5678	4516	4170	3496	4536
England and Wales, ..	3425	4386	5139	4494	3932	3298	4250

To each 100 deaths in 1889 the mean number in 1890-94 was 124.

* Table 6, showing Deaths in Males in England, Wales, and London from "Phthisis" and "All Tubercular Diseases" at various ages in ratio per 1000 of Males living in 1894.

Various Ages.	Phthisis.	All Tubercular Diseases.
Under 5 years, ...	·066	·59
From 5 years to 10 years, ...	·025	·029
,, 10 ,, 15 ,, ...	·030	·069
,, 15 ,, 20 ,, ...	·122	·235
,, 20 ,, 25 ,, ...	·201	·223
,, 25 ,, 35 ,, ...	·429	·459
,, 35 ,, 45 ,, ...	·436	·456
,, 45 ,, 55 ,, ...	·326	·341
,, 55 ,, 65 ,, ...	·171	·180
,, 65 ,, 75 ,, ...	·056	·060
Over 75 ,,	·006	·007
Totals	1·868	2·619

* Supplied from Registrar General's Report, 1894, pages 5, 14 114, 128

Post Office Staff, United Kingdom—Males.

* Tables 7, 8, 9, 10, showing Distribution, Strength, Deaths, and Invalids (with age at death) of Males of Post Office Staff of the United Kingdom in ratio per 1000 of strength, during 3 years.

1893.

Distribution.	Strength.	Deaths	Discharged as Invalids.	Average Age at Death.
England—				
Chief Office	10,267	1·7	·7	32
Metropolitan Districts	8,298	·8	·6	29
Country	27,710	1·1	·4	27
Scotland –	4,061	1·6	·4	34
Ireland—	2,547	2·7	·4	24
Averages ...		1·5	·5	29·2

1894.

Distribution.	Strength.	Deaths.	Discharged as Invalids.	Average Age at Death.
England—				
Chief Office	11,209	1·1	·8	30
Metropolitan Districts	8,781	1·0	·4	32
Country	28,057	1·3	·5	30
Scotland—	4,204	1·4	·7	30
Ireland—	2,605	4·2	·9	29
Averages .		1·8	·65	30·2

1895.

Distribution.	Stength.	Deaths.	Discharged as Invalids.	Average Age at Death.
England—				
Chief Office	11,345	1·5	1·4	32
Metropolitan Districts	8,744	·9	1·3	33
Country	29,272	1·3	·5	34
Scotland—	4,351	1·1	1·6	29
Ireland—	2,773	3·2	·9	31
Averages		1·6	1·14	31·8

Average Annual Invaliding Rate per 1000 ...	·79	2·39
Average Annnal Death Rate per 1000	1·6	
Average Age at Death	30·4	

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* Supplied from statistics kindly sent me by Dr A. Wilson, Physician-in-Chief to Post Office Staff.

Previous Prevalence of Phthisis in British Army.

* Table 11, showing annual mortality from Phthisis per 1000 of strength, and deaths from the disease out of 100 deaths from all causes.

DISEASES.	Mortality per Annum per 1000 strength. 1867-71 (5 years).	Deaths in 100 Deaths (5 years). 1867-71.	Mortality per Annum per 1000 strength. 1872-80 (9 years).	Deaths in 100 Deaths 1872-80 (9 years).	Mortality per Annum per 1000 strength. 1879-84 (6 years).	Deaths in 100 Deaths. 1879-84 (6 years).	Mortality per Annum per 1000 strength. 1886-87 (2 years).	Deaths in 100 Deaths. 1886-87 (2 years).	Mortality per Annum per 1000 strength. 1888 (1 year).	Deaths in 100 Deaths. 1888 (1 year).
Phthisis and Tubercular Diseases	2·64	30·26	2·29	29·0	2·08	30·9	1·47	25·0	1.23	22·2
Circulatory Diseases	1·46	16·71	1·17	14·8	0·66	9·8	0·45	7·6	0·41	7·4
Pneumonia - -	0·77	8·88	1·34	17·0	1·30	19·3	0·89	15·1	0·85	15·4
Violent Deaths - -	0·59	6·84	0·61	7·7	0·83	12·3	0·79	13·4	0·80	14·5
Suicides - - -	0·28	3·30	0·21	2·7						
Diseases of Nervous System - -	0·57	6·58	0·54	6·8	0·46	6·8	0·42	7·1	0·49	8·8
Continued Fevers—especially Enteric	0·40	4·63	0·30	3·8	0.30	4·4	0·4	6·8	0·34	6·1
Bronchitis - - -	0·16	1·91	—	—	—	—	0·12	2·0	0·07	1·2
Alcoholism - -	0·06	0·80	—	—	—	—	0·06	1·0	0·03	0·5
All other Diseases -	1·75	20·07	1·42	18·2	1·10	16·3	1·27	21·6	1·30	23·5

* Table 12, showing death and invaliding ratios, and these ratios combined, per 1000 of strength, in the arms named, during the period 1864-70. (Mean of 7 years).

Phthisis and Hæmoptysis, from Dr. Balfour's Report.	Household Cavalry.	Cavalry of the Line.	Foot Guards.	Infantry of the Line.	Depôts.
Died per 1000 ...	3·76	1·41	2·30	2·12	Not given.
Invalided per 1000 ...	8·23	4·02	9·49	5·51	
Total Died and Invalided per 1000 ...	11·99	5·44	11·74	7·63	

* Table 13. Similar to preceding Table, but covering the period 1871-76.

Phthisis and Hæmoptysis from Dr. Balfour's Report.	Household Cavalry.	Cavalry of Line.	Foot Guards.	Infantry of Line.	Depôts, 1873-76.
Died per 1000	3·33	1·46	2·43	2·15	4·18
Invalided per 1000 ...	4·44	4·30	7·17	4·60	9·82
Total Died and Invalided per 1000 ..	7·77	5·76	9·60	6·75	14·00

* Supplied from "Parker's Hygiene," pages 582 and 583

British Army.

* Table 14.—Deaths from all causes ; Admissions ; Deaths and Invalids (sent home) from Tubercular Diseases in the British Army during 1894, in ratios per 1000 of strength, and the average annual ratios for the period 1836-93.

Distribution.	Deaths from all Causes.	Ratios per 1000 of Strength.			Ratios per 1000 of Strength.		
		Admissions.	Deaths.	I'valids sent home.	Admissions.	Deaths.	I'valids sent home.
United Kingdom, ...	3·70	3·2	·80	†1 58	4·0	·94	†1·73
Gibraltar, ...	2·97	1·9	·64	1·49	1·9	·37	1·52
Malta, ...	5·81	2·8	1·01	1·26	2·6	·89	1·61
Cyprus, ...	3·45	1·7	—	—	·8	·21	·82
Canada, ...	4·16	2·1	2·08	2·08	2·0	·73	1·28
Bermuda, ...	8·51	—	—	—	2·0	·73	1·28
W. Indies (European Troops),	7·48	5·2	—	4·29	1·3	·22	1·0
South African and St. Helena,	6·31	2·5	·95	·95	2·7	·51	1·40
Mauritius, ...	10·29	1·7	1·72	—	2·8	·76	1·77
China, ...	17·98	3·4	3·46	1·38	4·5	·67	2·38
Straits Settlements	9·11	4·6	2·27	—	1·8	·75	1·51
Bengal, ...	—	2·7	·73	1·34	3·3	·87	1·45
Bombay	16·81	5·4	1·19	1·27	4·1	·85	1·44
Madras, ...	—	2·9	·60	2·01	3·0	·71	1·16
Ceylon, ...	10·63	3·5	·71	2·13	3·6	·97	2·26
Egypt, ...	8·61	2·3	·57	1·15	2·9	·64	1 86
*West Africa, ...	18·76	7·0	4·69	14·07	10·4	4·26	2·13
*West Indies, ...	9·42	12·9	4·39	—	7·7	2·87	—
On Board Ship, ...	7·34	—	—	—	—	—	—
	8·21	2·86	1·045	1·30	2·70	·67	1·42

* Black Troops are not included in averages. † Discharged Invalids.

* Table 15, showing prevalence of Tubercular Diseases in our own Army, Army and Navy, and of Phthisis in the Post Office Staff in ratios per 1000 serving (Males in P.O.).

	Year.	Admis'ons	Invalids	Deaths.	Invalids & Deaths.
Army—Total White Forces, ...	1894	2·86	a1·30	1·045	2 305
Army—United Kingdom, ...	1894	3·2	b1·58	·80	2·38
Army—England	1894	3·0	c1·49	·62	2·11
Navy—Total White Forces, ...	1895	·78	·15	—	·15
Navy—Home Stations, ...	1895	·72	·3	·27	·57
P.O.—United Kingdom, ...	1893 1894 1895	—	·79	1·6	2·39
P.O.—England, ...		—	·72	1·5	2·22

a Invalids sent home. b and c Invalids discharged from service.

* Supplied from the Director General's Statistics (A.M.D.), those of the Director General, Royal Navy, and tables sent by Dr. Wilson (Post Office).

Household Troops.

CAVALRY.

* Table 16, showing Strength, Admissions, Deaths, and Invalids (in ratio per 1000 of strength) during 1894 (a very favourable year) in Household Cavalry.

Strength.	Admissions.	Deaths.	Invalided.
1214	2·5	·82	1·6

—

INFANTRY.

* Table 17, showing Strength, Admissions, Deaths, and Invalids from Phthisis (in ratio per 1000 of strength) in Foot Guards stationed IN London in 1894.

Strength.	Admissions.	Deaths.	Invalids.
2838	4·2	1·05	2·8

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Table 18, showing Strength, Admissions, Deaths, and Invalids (in ratio per 1000 of strength) in Foot Guards stationed OUT OF London in 1894.

Strength.	Admissions.	Deaths.	Invalids.
1812	3·3	·5	·5

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* Tables compiled from Statistics supplied to me by the Medical Officers in charge of Troops in London, Dublin, Windsor, and Caterham. The admissions from the various Detachments (about 670 men) are most difficult to ascertain with any degree of exactness.

United States A. Army.

* Table 19, showing Admissions and Deaths, in ratios and annual average ratios per 1000 of strength, from Phthisis during 1894, and the octennial period preceding 1894, and decennial period preding 1893.

YEAR.	ADMISSIONS. In ratio per 1000 of mean strength.	DEATHS. In ratio per 1000 of mean strength.
1886	3·52	·50
1887	3·40	·49
1888	3·52	·45
1889	3·32	·44
1890	3·26	·71
1891	2·97	·42
1892	4·34	·71
1893	2·85	·61
1894	2·90	·55
Decennial Period 1883-93.	3·39	·54
Averages for 1886-93. ..	3·33	·54

* Table 20, showing Deaths from Phthisis at various ages in average annual ratio per 1000 of strength for the period 1890-1894—United States Army.

19 and under	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60 and over
0	·56	·57	2·45	·62	3·02	2·73	·68	2·61	12·50

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* Supplied from Statistics sent to me by Surgeon-General Sternburg, U.S.A. Army.

United States Navy.

* Table 21, showing Admissions and Deaths from Phthisis and "All Tubercular Diseases" in ratio per 1000 of strength during 1894.

Diseases.	Average in ratio per 1000 of strength.	Deaths in ratio per 1000 of strength.
Phthisis	4·17	·94
All Tubercular Diseases	4·48	·94

* Table 22, showing Admissions and Deaths from Phthisis and all Tubercular Diseases during the octennial preceding 1894, in ratio per 1000 of strength.

Year.	PHTHISIS.		ALL TUBERCULAR DISEASES.	
	Admissions in ratio per 1000 of Strength.	Deaths in ratio per 1000 of strength.	Admissions in ratio per 1000 of strength.	Deaths in ratio per 1000 in strength.
1886	4·37	·73	4·37	·75
1887	5·30	1·83	5·40	1·93
1888	4·10	1·46	4·39	1·55
1889	3·68	1·14	4·03	1·14
1890	4·26	1·17	4·34	1·17
1891	4·87	·51	5·30	·76
1892	3·26	·67	3·59	·67
1893	3·25	·41	3·66	·49
Averages	4·13	·99	4·38	1·05

* Supplied from statistics sent to me by the Surgeon-General United States A. Navy.

Imperial Prussian Army.

* Table 23, showing Admissions and Deaths in ratio per 1000 of strength, from Phthisis, during 1893.

Year.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1893	2·2	·36

* Table 24, showing Total Admissions, and the ratio per 1000, from Phthisis during the octennial preceding, 1894.

Year.	Total Admissions and—	Ratio per 1000 strength.
1886	889	2·3
1887	893	2·3
1888	945	2·3
1889	1·005	2·4
1890	1·000	2·4
1891	1·276	2·9
1892	1·279	3·0
1893	972	2·2
		Average Ratio 2·4

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* Supplied from Statistics sent to me by General Staff-Surgeon Von Colér, of the Imperial Prussian Army.

German Navy.

* Table 25, showing No. of admissions and ratio per 1000 of strength during the years 1885-95 ; also, average annual ratio.

Year.	No. of Cases of Admission.	Ratio per 1000 of Strength.
1885-86	39	2·7
1886-87	42	2·9
1887-88	41	2·8
1888-89	44	2·9
1889-90	54	3·5
1890-91	49	3·1
1891-92	42	2·5
1892-93	47	2·4
1893-94	31	1·6
1894-95	37	1·8
1885-95	426	Average—2·6

* Table 26, showing the number of Deaths, and ratio per 1000 of strength during the years 1885-95 ; also, average annual ratio.

Year.	No. of Cases of Deaths.	Ratio per 1000 of Strength.
1885-87	42	1·5
1887-89	22	·7
1889-91	30	1·0
1891-93	22	·6
1893-95	21	·5
1885-95	137	Average— ·8

* Supplied from statistics sent me by Surgeon-Genl. Gukschow, German Navy

Italian Army.

* Table 27, showing total Strength, Admissions to Military Hospitals, Deaths in Civil and Military Hospitals from Phthisis; also shown in ratio per 1000 of Strength.

Year.	Total Strength.	PHTHISIS.		RATIO PER 1000 OF STRENGTH,	
		Admissions to Military Hospitals (not given for Civil Hospitals.	Deaths in Military and Civil Hospitals.	Admissions to Military Hospitals	Deaths in Military and Civil Hospitals.
1886	204,428	158	212	·77	1·04
1887	212,898	172	170	·81	·80
1888	209,918	181	225	·87	1·08
1889	218,917	213	265	·98	1·21
1890	221,384	269	319	1·22	1·44
1891	220,714	243	292	1·10	1·32
1892	213,307	247	227	1·16	1·07
1893	214,439	215	173	1·00	·81
Totals and Averages	1,716,005	1,698	1,883	·99	1·10
1894	194,670	174	120	·89	·63
1895	202,915	210	169	1·04	·83

The number admitted annually to Civil Hospitals is unknown, the deaths only are recorded.

Italian Navy.

† Table 28, showing Admissions and Deaths from "Phthisis" and "All Tubercular Diseases" in 1894; also the Average Admissions and Deaths from Phthisis for the period 1883-92, in ratio per 1000 of Strength.

Year.	PHTHISIS		ALL TUBERCULAR DISEASES.	
	Admissions.	Deaths.	Admissions.	Deaths.
1894	1·91	·59	2·09	·68
1883-92	1·56	.36	—	—

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* Supplied from Statistics sent to me by Dr. Ridalfo Livi, "Captain Medicin," attached the Minister of War (Rome).

† Supplied from the Statistics sent to me by the Surgeon-in-Chief, Italian Navy.

Swedish Army.

* Table 29, showing Admissions and Deaths from Phthisis in ratio, per 1000 of strength, from 1886 to 1894. Also average annual ratios for octennial preceding 1894.

YEAR.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1886	7·1	·9
1887	4·1	·6
1888	2·3	1·1
1889	2·2	·2
1890	2·3	1·1
1891	1 6	·3
1892	3·0	·7
1893	2·1	·6
1894	4·0	1 4
Averages for Octennial period before 1894	3.08	·68

Only the troops under arms all the year round are considered in making up these statistics.

French Army.

* Table 30, showing Admissions and Deaths from Phthisis in ratio per 1000 of strength, during 1894.

YEAR.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1894	6·13 Admission rate has increased 2 per 1000 since 1890. (Dujardin-Beaumetz).	1·01

The Federal Army of Switzerland.

* Table 31, showing Admissions and Deaths from Phthisis, in ratio per 1000 of strength, during 25 days (this being the amount of military service exacted from each soldier annually).

YEAR.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1895	·5 Men under arms for 25 days Annually.	·033

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* Supplied from statistics sent to me by (1) the Adjutant to the Director-General, Medical Staff, Swedish Army; (2) M. le Médecin Inspecteur-Genl. Dujardin-Beaumetz, French Army; (3) Colonel Spriglar, Surgeon-General, Swiss Army.

Austrian Army.

*Table 32, shows Admission and Death-rates for year 1895.

Year.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1895	1·5	·28

*Table 33, shows Admission-rates for the years named.

Year.	ADMISSIONS per 1000 of strength.	Sources whence ratios were derived.
1886	4·3	refers to "Frontier Guards.'
1887	3·8	
1888	3·9	
1889	3·7	refers to the "Präsenz Standes".
1890	4·1	
1891	3·9	
1892	3·5	
1893	3·2	
1894	1·9	refers to total Forces.
1895	1·5	

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* Supplied by the Surgeon-General, Austrian Army. By permission of the War Minister.

Belgian Army.

* Table 34, showing Admissions and Deaths from Phthisis in ratio per 1000 of strength during the year 1894.

Year.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1894	3	·8

* Table 35, showing the Admissions and Deaths from Phthisis during the octenniel preceding 1894, in ratio per 1000 of strength, with average annual ratios.

YEAR.	ADMISSIONS. In ratio per 1000 of strength.	DEATHS. In ratio per 1000 of strength.
1896	1·3	·9
1887	2·0	·9
1888	2·3	1·2
1889	1·6	1·0
1890	1·8	·9
1891	2·6	1·0
1892	2·1	·7
1893	3·5	.7
Averages	2·1	·9

* Supplied from Statistics sent to me by Dr. Mullier, Surgeon-General, Belgian Army.

Various Armies.

* Table 36, showing Admissions and Deaths from "Phthisis" and "All Tubercular Diseases" in ratio per 1000 of Strength (also the General Death-rate in the countries named) in the years and periods named.

	General Death-Rate per 1000 of Civilian Populations.	Year and Periods.	Admissions per 1000 of strength.		Deaths per 1000 of strength.	
			Phthisis.	All Tuberc'l'r Diseases.	Phthisis.	All Tuberc'l'r Diseases.
UNITED KINGDOM	16·8 (1894)	1894 1886-93	— —	2·86 2·7	— —	1·045 ·67
UNITED STATES, AMERICA. Red and Black Troops included.		1894 1883-93	2·90 3·39	— —	·61 ·54	— —
PRUSSIA	22·05 (1894)	1893 1886-93	2·2 2·4	— —	·36 —	— —
ITALY	25·1 (1894)	1894 1886-93	·89 ·99 Military Hospitals only.	— —	·63 1·10 Military & Civil Hospitals	— —
BELGIUM	18·6 (1894)	1894 1886-93	3·0 2·1	— —	·8 ·9	— —
SWEDEN	16·8 (1893)	1894 1886-93	4·0 3.08	— —	1·4 ·68	— —
SWITZERLAND	20·7 (1894)	1895	·5	—	·033	—
AUSTRIA	27·1 (1893)	1894 1886-93	1·9 3·8	— —	·28 in 1895.	—
FRANCE.	22·8 (1893)	1894	6·13	—	1.01	—

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* Supplied from the various Military Headquarters mentioned under the Tables in Appendix, and from the Registrar-General's Report, 1894, page 100.

Five Navies Contrasted.

* Table 37, showing Admissions and Deaths from Phthisis or Tubercular Diseases in British, American, German, Italian, and Russian Navies, in ratio per 1000 of strength, for 1894 and other periods.

		Admissions per 1000 of Strength.	Deaths per 1000 of Strength.
(Tubercular Diseases.)			
British Navy,	1894	·83	·24
	1887-93	·64	·17
U. S. A. Navy,	1894	4·17	·94
	1886-93	4·13	·41
German Navy,	1894	1·8	93-95, ·5
	1885-95	2·6	85-95, ·8
Italian Navy,	1894	1·91	·59
	1883-92	1·56	·36
Russian Navy,	1894	4·8	3·0
	1885-98	9·8	3·5

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* Supplied from Statistics sent to me by the various Naval Authorities already mentioned under tables dealing with countries indicated.

Table W, showing prevalence of Phthisis in the various Military Districts of Russia in ratio per 1000 healthy men.

DISTRICT.	1887	1888	1889	1890	1891	1892	1893	1894	1895
St. Petersburg, ...	9·1	8·7	8·5	8·8	7·4	8·5	7·9	8·2	7·2
Finland,..	6·6	6·0	3·5	3·6	3·5	2·8	2·2	2·2	2·8
Vilna	3·4	4·5	3·6	4·1	3·3	4·7	4·5	4·9	4·8
Warsaw, ...	7·1	6·8	6·8	7·2	5·5	4·5	4·3	4·2	5·7
Kieve, ...	2·7	2·6	2·9	2·8	2·7	3·3	3·3	2·6	3·0
Odessa	2·9	3·4	2·5	2·5	3·1	3·7	3·1	3·0	2·8
Moscow, ...	3·6	3·3	4·7	4·2	4·7	4·6	4·4	3·7	4·3
Kazan, ...	3·8	3·3	3·1	2·5	3·2	4·4	5·2	6·5	6·7
Caucasus, ...	2·1	1·9	2·8	3·0	2·6	2·3	3·1	2·6	2·6
Omekin?	3·7	3·8	3·9	3·6	2·0	2·2	2·6	2·8	3·8
Turkestan, ...	2·0	3·0	2·6	1·4	2·5	1·6	1·0	1·2	1·8
Saghalien, ...	1·7	1·3	1·5	1·7	1·5	2·4	1·8	2·3	1·9
Trans-Caspian	(*a*)	(*a*)	2·5	1·3	·7	1·7	1·2	1·9	1·8
Don, ...	(*a*)	2·8	1·8	2·1	2·0	4·5	2·5	6·1	3·6
Ir, ...	1·8	2·3	4·9	3·1	2·9	2·4	1·5	1·0	2·1
Average, ...	3·8	3·8	3·7	3·4	3·3	3·6	3·2	3·6	3·6

(*a*) Not recorded.

* Table X, showing prevalence of Phthisis in the various Arms of the Russian Army, in ratio per 1000 of healthy men

Arm of Service.	1893.	1894.	1895.
Foot Guards	12·4	11·5	12·7
Grenadiers	4·6	5·1	4·4
Infantry	4·2	4·0	3·9
Light Infantry	2·3	2·2	2·3
Line Battalions	1·3	2·1	2·0
Engineers	4·5	3·9	7·1
Transport	2·8	5·1	4·4
Reserve	3·6	4·0	4·8
Depôts	2·1	2·1	3·1
Household Cavalry ..	6·0	7·9	6·4
Cavalry	3·4	3·2	3·8

* Table Y, showing, in ratio per 1000 of healthy men, the Admissions to Hospital and Deaths from Phthisis in the Russian Navy during the years 1885-1895.

Year.	Admissions.	Deaths.
1885	13·1	3·4
1886	23·1	5·7
1887	18·3	4·1
1888	9·3	3·3
1889	8·2	3·2
1890	6·9	4·2
1891	7·4	3·5
1892	7·3	3·6
1893	4·6	3·1
1894	4·8	3·0
1895	5·2	2·2
Average ..	9·8	3·5

Table Z, showing death-rate from Phthisis and its relation to age in the Japanese Army over the period 1888-93 in a standing army of 51,371.

AGE.	1888	1889	1890	1891	1892	1893	Average.
Under 20 years, .. .	—	4	3	1	—	—	1·33
" 21 "	2	1	4	4	2	—	2·17
" 22 " ...	5	5	5	2	1	1	3·17
" 23 "	3	6	4	3	3	4	3·83
" 24 " . ..	4	3	5	3	5	3	3·83
" 25 "	3	1	—	1	—	1	1·0
Total, ...	17	20	21	14	11	9	15·33
Above 25 years, ...	3	3	4	1	1	3	2·50
General Total, ...	20	23	25	15	12	12	17·83
Average ratio per 1000, .	—	—	—	—	—	→	·35

APPENDIX BRIEFLY REVIEWED.

Table 1. Shows that since 1875 there has been a steady decrease in "Phthisis" and "All Tubercular Diseases" in England and Wales till 1890, when they increased slightly, but since that year the decrease continues.

Table 2. Shows a fall of 21 has occurred in England and Wales in the death-rate from Phthisis in 1894, from the average ratio of the 10 preceding years.

Table 3. That in England and Wales, in 1894, out of the 15 most frequent causes of death, Phthisis is the second most frequent.

Table 4. Shows that nearly 3 times as many deaths occurred in 1894 from Phthisis as from all the other forms of tubercular diseases.

Table 5. Shows the great increase in the death-rate in England and Wales in 1890–91-92, attributed to Influenza and Diseases of Respiratory Organs.

Table 6. Shows the ratio per 1000 of deaths from "Phthisis" and "All Tubercular Diseases" amongst males in England and Wales and London in 1894, at various ages; also, that the mortality is highest between the 25 and 35 years of life.

Tables 7, 8, 9, 10 Show that Phthisis is very prevalent amongst the Males of the Post Office Officials: that the disease is slightly increasing amongst them: that it is most prevalent in Ireland, and least so in the Metropolitan District: that the disease proves fatal generally at the 30th year of life in this class.

Tables 11, 12, 13. Show the great prevalence of Phthisis in our own Army in former years—that the greatest prevalence existed in the Troops quartered in London—that the Line Regiments suffered least: that in all, a steady fall in the disease has occurred.

Table 14. Shows that, compared with the prevalence of the diseases in population of England and Wales, Tubercular Diseases are more prevalent in the British Army: that this becomes more apparent when deaths from all causes per 1000 males living in civilian and military life, are borne in mind (17.6 per 1000 being the general death ratio in males in 1894, amongst civilians; 8.21 per 1000 representing the ratio of deaths from all causes in the Army): that the greatest numbers of

invalids sent home suggest a partial explanation of the high rate of Phthisis in the troops in the United Kingdom: that among white troops there is a remarkable uniformity in the prevalence of tubercular diseases, no matter where stationed: that black troops are more liable to tubercular diseases than white: that a diminution from tubercular diseases, if proceeding at all at present, proceeds at a slower rate than the diminution in the death-rate from tubercular diseases in England and Wales, during the last 9 years.

Table 15. Shows that of the Army and Navy, the latter is more free from tubercular diseases: that contrasted with the death-rate from tubercular diseases, in the male population of England and Wales in 1894, the Navy is the more exempt: that considering the period of life spent in the Army, the latter is less exempt from tubercular diseases than the general male population at a corresponding period of life: that compared with the Post Office Officials, there is a slight excess of tubercular diseases in the Army.

Tables 16, 17, 18. Show that, when compared with tables 12 and 13, there is evident a very decided diminution of tubercular diseases in the Household Troops: that the improvement is most marked in the Cavalry, and least so amongst the Foot Guards stationed in London.

Tables 19, 20. Show the prevalence of Phthisis in U. S. A. Army.

Tables 21, 22. Show that the U. S. A. Navy has a higher rate of Phthisis when compared with the British Navy ; also, that Phthisis seems more prevalent in the American Navy than Army.

Tables 23, 24. Show the remarkable uniformity of the prevalence of Phthisis in the Prussian Army: that it is about equally prevalent to that of the British Army.

Tables 25, 26. Show that the Phthisis rate in the German Navy is about equal to that in the Prussian Army.

Table 27. Shows statistics regarding Phthisis in the Italian Army, but owing to the impossibility in finding the Admission ratio of men who go to Civilian Hospitals it is impossble to estimate the true admission rate : that the death-rates are high in Civilian and Military Hospitals in Italy: that no decrease can be noticed in the disease.

Table 28. Shows that in the Italian Navy Phthisis appears to be slightly more prevalent than in the Italian Army, but from the previous note it will be seen that this may only be an apparent and not an actual excess.

Table 29. Shows the rather high admission-rate from Phthisis in

the Swedish Army, but that in that army the disease is decidedly diminishing.

Table 30. Shows the very high admission-rate from Phthisis in the French Army: that the ratio has gone up 2 per 1000 since the Influenza pandemic.

Table 31. Shows little of any value.

Tables 32, 33. Show the prevalence of Phthisis in the Austrian Army : that it has decidedly diminished of late years (this owing to the various reforms in equipment, clothing, etc of the men recently introduced).

Tables 34, 35. Show the rates of admission, etc., from Phthisis in the Belgian Army, how that a rise has occured since the Influenza pandemic.

Tables 36 and 37 bring the Appendix to an end. They show that, compared with the great armies and navies brought under review in this inquiry, the British Army and Navy suffer least from Phthisis.

Tables W, X, Y, Z, arrived late: they are placed at the end of this Appendix. They are of very great interest.